Household Debt and Business Cycles Worldwide: Online Appendix

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Data Appendix

Household debt and non-financial firm debt. Household and non-financial firm debt are from the BIS's "Long series on credit to the private non-financial sector" database. See text for details on the private debt to GDP variables.

National accounts. National accounts data are from the World Bank's World Development Indicators (WDI) database. We use annual data in current and constant prices from the WDI on GDP, Y, household consumption, C, gross capital formation, I, and government consumption, G. We supplement WDI data on total household consumption with data on household consumption expenditure on durable goods, C^{dur}, and non-durable goods, C^{nondur}, from the OECD and national statistical offices.[1] We also collect data on investment by type of good from the OECD.

Exports, imports, and the current account. Data on exports, X, and imports, M, in current prices are from the OECD or International Monetary Fund's International Financial Statistics (IFS) database, depending on data availability. Net exports is the difference between exports and imports, $NX = X - M$. Current account series, CA, are from the OECD or IFS.

Disaggregated exports and imports. In addition to overall exports and imports, we construct variables for consumption and non-consumption (capital and intermediate) trade using disaggregated trade data from the NBER-UN World Trade database (from 1962-2000) and UN Comtrade (from 2000-2012). We aggregate four digit SITC revision 2 trade flows into consumption, capital, and intermediate imports and exports following the Basic Economic Categories classification scheme from UN Comtrade. With consumption exports and imports, XC and MC, we construct the share of consumption in total exports and imports, s^{XC} and s^{MC}.

Unemployment rate. Data on national unemployment rates, u, are from the OECD harmonized unemployment rate database, where possible. For countries where the OECD harmonized unemployment rate is series is short or missing, we use unemployment rate data from the IFS, other OECD series, or national central banks. The harmonized unemployment rate is measured by applying the same definition of unemployment across OECD member countries to obtain estimates that are more internationally comparable. However, since we focus on changes in the unemployment rate, level differences in definitions that are constant over time will not bias the results.

[1] These series are available for 23 of the 30 countries in the sample. Information on durable and non-durable consumption is missing for Hong Kong, Indonesia, Singapore, Switzerland, Thailand, Thailand, and Turkey. The OECD decomposes final consumption expenditure of "households on the territory" into non-durable, semi-durable, durable, and services consumption.

Sovereign and credit spreads. The sovereign spread, spr, is constructed as the difference between the 10-year government bond yield and the 10-year U.S. Treasury yield. Government 10-year bonds yields are from Global Financial Data (code "IG-ISO-10"). The real sovereign spread is the nominal spread minus the difference in CPI inflation rates.

The mortgage-sovereign spread, spr_t^{MS}, is the difference between the mortgage lending rate and the 10-year government bond yield. The mortgage lending rate is from Global Financial Data (code "IL-ISO-M"). For Denmark we use the yield on 10 year mortgage bonds instead of the mortgage lending rate ("INDNK10D"), and for Sweden we use the yield on 5 year mortgage bonds from GFD ("INSWE5D"). For Japan we use the interest rate on building society mortgages from Datastream, and for Korea we use the 5 year mortgage bond yield from the Bank of Korea via Datastream. The sample includes a mortgage-sovereign spread for 26 countries out of 30 countries.[2] The mortgage lending rate refers to the rate on fixed or variable rate loans for home purchase, depending on the prevalent contract in each country. Maturity typically ranges from 5 to 30 years.

Corporate credit spreads, spr_t^{corp}, are constructed as the difference between the corporate bond yield and the 10-year government bond yield. For 15 countries the corporate bond yield series are from Global Financial Data (code "IN-ISO").[3] For 6 other countries we obtained series on the corporate lending rate from Global Financial Data (code "IL-ISO").[4] For the United States the corporate credit spread is the Baa-Aaa spread (average of Q4 monthly values).

All interest rate series are aggregated to annual series by taking quarterly averages of daily, weekly, or monthly rates and using the fourth quarter value. For eurozone countries, we use the Germany 10-year government bond yield as the benchmark rate.[5]

Professional GDP growth forecasts and forecast errors. We use GDP growth forecasts and forecast errors from the IMF *World Economic Outlook* (WEO) Historical Forecasts Database and from print editions of the *OECD Economic Outlook*. Forecasts from the *OECD Economic Outlook* are hand-collected. Forecast errors are defined as the difference between realized and forecasted growth. To construct forecast errors we use realized GDP growth for year t reported in year $t+2$. This allows us to compare forecasts with realized growth rates based on proximate vintages of data.[6] The WEO Historical Database reports forecasts for growth up to the five year horizon since 1990. We supplement this information with IMF one-year ahead forecasts for the G7 countries from 1972 onward. One-year and two-year ahead forecasts from the *OECD Economic Outlook* are available since 1973 and 1987, respectively.

Government debt to GDP. The government debt to GDP ratio, GD/Y, is from the IMF's Historical Public Debt Database (Abbas et al. (2010)). To construct changes in government debt

[2]The mortgage sovereign spread is missing for Hong Kong, Indonesia, Thailand, and Turkey.

[3]The 15 countries are Australia, Austria, Belgium, Canada, Denmark, Germany, Italy, Japan, Korea, Netherlands, Norway, Spain, Sweden, Switzerland, and the United Kingdom.

[4]These countries are Finland, France, Greece, Ireland, Poland, and Portugal.

[5]Specifically, we use the German 10-year government bond yield for Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, and Spain starting in 1999 and for Greece starting in 2001.

[6]All results based on forecast errors are robust to using realized GDP growth from the WDI instead of the WEO Historical Database or the *OECD Economic Outlook*.

to GDP, we do not take differences across breaks in the series.

Real house prices. Real house prices, HPI, are constructed from the BIS's "Long series on nominal residential property prices." These series cover 20 countries in our sample and start in 1970 or 1971.[7] Annual growth in real house prices are constructed from changes in fourth quarter values, deflated by the CPI.

Real effective exchange rates. Real effective exchange rates, $REER$, are from the BIS's "Effective exchange rate indices" database. We use the narrow indices, which extend back to 1964 for 24 countries in our sample.[8] An increase in the index indicates an appreciation.

Exchange rate regime. Information on the *de facto* exchange rate regime is from Reinhart and Rogoff (2004), updated to 2010 in Ilzetzki et al. (2010). We define "Fixed regimes" as arrangements with a coarse classification code equal to 1 (currency boards, a pre-announced horizontal band that is narrower than or equal to $\pm 2\%$, or a de facto peg). "Intermediate regimes" are defined as arrangements with a classification code of 2 or 3 (crawling pegs, crawling bands, managed floating, moving bands, etc.).

[7] The countries without house price series from the BIS are Austria, Czech Republic, Greece, Hungary, Indonesia, Mexico, Poland, Portugal, Singapore, and Turkey.

[8] Countries without REER series are Czech Republic, Hungary, Indonesia, Poland, Thailand, and Turkey.

Simple Model of Permanent Income Shocks and Credit Demand

In this section we summarize a simple model where household debt expands today in anticipation of higher income tomorrow. Consider a small open economy with exogenously given output and a continuum of infinitely lived households. Output y_t follows a stochastic process with $\psi_t^{t+j} = E_t \Delta y_{t+j}$ representing the expected change in income j periods forward at time t. Unanticipated changes in income can be driven by shocks such as technology shocks, natural resource discovery, or terms of trade shocks. Households face no borrowing constraints and maximize,

$$E_0 \sum_{t=0}^{\infty} \beta^t u(c_t).$$

There is a risk-free one period bond that can be traded internationally with each household facing a sequential budget constraint,

$$c_t + (1+r)d_{t-1} = y_t + d_t, \tag{1}$$

and a no-Ponzi game constraint,

$$\lim_{j \to \infty} E_t \frac{d_{t+j}}{(1+r)^j} = 0. \tag{2}$$

The Euler equation of this problem can be written as $u'(c_t) = \beta(1+r)E_t u'(c_{t+1})$. Assuming $\beta(1+r) = 1$ and quadratic utility with $U(c) = -\frac{1}{2}(c - \bar{c})^2$ with $c \leq \bar{c}$, makes marginal utility linear and hence consumption a random walk with $c_t = E_t c_{t+1}$. Iterating forward (1) and using (2) and $c_t = E_t c_{t+1}$, we get that consumption equals expected permanent income $E_t y_t^p$ minus interest payments on outstanding debt $r d_{t-1}$ in equilibrium,

$$c_t = E_t y_t^p - r d_{t-1} = \frac{r}{(1+r)} E_t \sum_{j=0}^{\infty} \frac{y_{t+j}}{(1+r)^j} - r d_{t-1}. \tag{3}$$

Plugging $c_t = E_t y_t^p - r d_{t-1}$ into equation (1), we can write down the change in debt at time t in terms of the present value of expected changes in future income:

$$\Delta d_t = \sum_{j=1}^{\infty} \frac{\psi_t^{t+j}}{(1+r)^j}. \tag{4}$$

Productivity shocks thus generate a positive relation between the change in debt and subsequent output growth. Growth in debt is driven by higher demand for credit in response to expected future income growth and a desire to smooth consumption.

References

Abbas, S. A., N. Belhocine, A. ElGanainy, and M. Horton (2010). A historical public debt database. IMF Working Papers.

Ilzetzki, E., C. M. Reinhart, and K. S. Rogoff (2010). Exchange rate arrangements entering the 21st century: Which anchor will hold? Working Paper.

Jordà, O. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review 95*(1), 161–182.

Reinhart, C. M. and K. S. Rogoff (2004). The modern history of exchange rate arrangements: A reinterpretation. *Quarterly Journal of Economics 119*(1), 1–48.

Table A1: Summary of Countries in the Sample and Key Statistics

Country	Years	Average Δd^{HH}	Average Δd^{HH}	Std. dev. Δd^{F}	Std. dev. Δd^{F}
Australia	1977-2012	2.23	1.00	2.55	4.40
Austria	1995-2012	0.71	1.98	1.26	2.91
Belgium	1980-2012	0.82	3.09	1.13	6.47
Canada	1969-2012	1.42	1.00	2.37	3.54
Czech Republic	1995-2012	1.24	-0.85	1.71	5.46
Denmark	1994-2012	3.72	2.52	3.96	5.96
Finland	1970-2012	1.12	0.87	3.04	7.55
France	1977-2012	1.08	1.10	1.20	2.41
Germany	1970-2012	0.51	0.23	1.79	1.65
Greece	1994-2012	3.22	1.98	2.25	2.43
Hong Kong	1990-2012	1.21	1.88	2.68	10.40
Hungary	1989-2012	0.52	2.06	3.41	5.34
Indonesia	2001-2012	0.96	-0.22	0.77	1.83
Ireland	2002-2012	5.02	14.11	7.97	15.63
Italy	1960-2012	0.70	0.52	1.55	2.98
Japan	1964-2012	0.92	0.14	1.77	4.39
Korea, Rep.	1962-2012	1.71	1.74	2.22	5.83
Mexico	1994-2012	0.20	-1.07	0.86	2.12
Netherlands	1990-2012	3.62	0.95	2.75	4.10
Norway	1975-2012	1.17	1.37	3.42	5.89
Poland	1995-2012	1.91	1.37	2.03	2.59
Portugal	1979-2012	2.57	1.18	2.51	7.22
Singapore	1991-2012	1.78	-0.21	2.88	5.28
Spain	1980-2012	1.78	1.64	2.64	5.01
Sweden	1980-2012	1.11	3.66	2.66	8.47
Switzerland	1999-2012	0.95	0.76	3.27	4.01
Thailand	1991-2012	1.99	-0.85	3.32	7.86
Turkey	1986-2012	0.72	0.66	1.19	3.51
United Kingdom	1976-2012	1.73	1.66	2.44	4.27
United States	1960-2012	0.75	0.54	2.14	1.76

Notes: This table lists the 30 countries in the sample and the years covered in the main regressions. The last four columns report the mean and standard deviation of the changes in household debt to GDP and non-financial firm debt to GDP for each country.

Table A2: Average U.S. High-yield Share between $t-3$ to $t-1$ as an Instrument for U.S. Credit Expansion

	OLS	First stage			IV		
	(1) $\Delta_3 y_{it+3}$	(2) $\Delta_3 d^{Private}_{it-1}$	(3) $\Delta_3 d^{HH}_{it-1}$	(4) $\Delta_3 d^{HH}_{it-1}$	(5) $\Delta_3 y_{it+3}$	(6) $\Delta_3 y_{it+3}$	(7) $\Delta_3 y_{it+3}$
Avg HYS, t-3 to t-1		0.214**	0.167*	0.167*			
		(0.0669)	(0.0704)	(0.0729)			
$\Delta_3 d^{Private}_{it-1}$					-0.507+		
					(0.263)		
$\Delta_3 d^{HH}_{it-1}$	-0.441**					-0.650*	-0.644+
	(0.158)					(0.310)	(0.333)
Distributed Lag in Δy				✓			✓
F statistic		10.26	5.632	5.271			
R^2	.22	.234	.26	.273	.023	.17	.217
Observations	46	46	46	46	46	46	46

Notes: This table shows instrumental variables time series regressions for the United States using the average high yield share during over $t-3$ to $t-1$ as an instrument for the expansion in private or household debt to GDP between $t-4$ and $t-1$. The high yield share is from Greenwood and Hanson (2013) and is defined as the share of non-financial corporate bond issuance in each year with a high yield rating from Moody's. Columns (4) and (7) include three real GDP growth lags, $\Delta y_{it-1}, \Delta y_{it-2}$, and Δy_{it-3}, as controls. Newey-West HAC standard errors in parentheses with a truncation parameter of 6.

Table A3: Household Debt Expansion Predicts Downward Forecast Revision

	Revision of $t+2$ Growth Forecast		Revision of $t+3$ Growth Forecast	
	(1) $rev^{IMF}_{t+2\|t,t+1}$	(2) $rev^{OECD}_{t+2\|t,t+1}$	(3) $rev^{IMF}_{t+3\|t,t+1}$	(4) $rev^{IMF}_{t+3\|t+1,t+2}$
$\Delta_3 d^{HH}_{it-1}$	-0.027*	-0.037+	-0.011*	-0.043**
	(0.013)	(0.021)	(0.0043)	(0.016)
$\Delta_3 d^{F}_{it-1}$	-0.0077	-0.0049	-0.0019	-0.0021
	(0.0087)	(0.0067)	(0.0037)	(0.0073)
Country Fixed Effects	✓	✓	✓	✓
R^2	0.038	0.041	0.012	0.060
Observations	484	473	484	484

Notes: This table reports regressions GDP forecast *revisions* on the expansion in household and non-financial firm debt to GDP. Columns 1 and 2 report results for the revisions in the forecast of $t+2$ growth made between t and $t+1$, $rev^{f}_{t+2|t,t+1} = \Delta y^{f}_{t+2|t+1} - \Delta y^{f}_{t+2|t}$. In Column 3 the dependent variable is the revision between t and $t+1$ of the $t+3$ growth forecast, while in column 4 the dependent variable is the revision between $t+1$ and $t+2$ of the same $t+3$ growth forecast. Reported R^2 values are from within-country variation. Standard errors in parentheses are dually clustered on country and year. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table A4: Alternative Hypotheses and Robustness to Other Known Predictors of GDP Growth

	Consumption or Residential Investment Booms			Real Exchange Rate	Time Trends	Corporate Credit Spread			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$	$\Delta_1 y_{it+1}$	$\Delta_1 y_{it+1}$	$\Delta_3 y_{it+3}$	$\Delta_3 y_{it+3}$
$\Delta_3 d^{HH}_{it-1}$	-0.325**	-0.401**	-0.385**	-0.316**	-0.207**	-0.0457*	-0.0447**	-0.249**	-0.250**
	(0.0778)	(0.108)	(0.0992)	(0.0783)	(0.0767)	(0.0210)	(0.0152)	(0.0704)	(0.0705)
$\Delta_3 d^{F}_{it-1}$	-0.0484	-0.0347	-0.0314	-0.0333	-0.0603+	-0.0337+	-0.0220+	-0.0486	-0.0343
	(0.0357)	(0.0547)	(0.0494)	(0.0391)	(0.0314)	(0.0183)	(0.0129)	(0.0376)	(0.0323)
$\Delta_3 (C/Y)_{it-1}$	-0.0350								
	(0.208)								
$\Delta_3 (C^{dur}/Y)_{it-1}$		0.794							
		(0.524)							
$\Delta_3 \frac{I^{res}}{Y}_{it-1}$			-0.424						
			(0.416)						
$\Delta_3 reer_{it-1}$				-0.0220					
				(0.0366)					
spr^{corp}_{it}							-1.220**		-1.476**
							(0.302)		(0.392)
spr^{corp}_{it-1}							0.413*		0.232
							(0.205)		(0.461)
Country Fixed Effects	✓	✓	✓	✓	✓	✓	✓	✓	✓
Distributed Lag in Δy	✓	✓	✓	✓	✓	✓	✓	✓	✓
Country-specific Time Trends					✓				
R^2	0.148	0.186	0.194	0.120	0.443	0.0504	0.194	0.104	0.158
Observations	684	425	548	606	695	487	487	451	451

Notes: This table reports robustness to controlling for other known predictors of GDP growth in our main single equation specification. Columns 1-3 control for the change in the consumption to GDP ratio, the change in the durable consumption to GDP ratio, and the change in the residential investment to GDP ratio from $t-4$ to $t-1$, respectively. Column 4 includes the change in the log real effective exchange rate from $t-4$ to $t-1$. The real effective exchange rate is from the BIS's "Effective exchange rate indices" dataset. Column 5 controls for country-specific time trends, and columns 6-9 include the corporate bond spread in year t and $t-1$. All columns include country fixed effects and three lags of GDP growth ($\Delta y_{it-1}, \Delta y_{it-2}$, and Δy_{it-3}). Reported R^2 values are from within-country variation. Standard errors in parentheses are dually clustered on country and year. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Table A5: Root Mean Squared Errors of Pseudo Out-Of-Sample GDP Growth Forecasts, 2000-2012

Forecast Horizon	IMF	OECD	VAR	AR	RW
1 year	2.33	2.06	2.69	2.86	3.22
2 years	2.73	2.79	2.81	2.97	3.69
3 years	2.90		2.95	3.07	3.81
4 years	2.97		2.94	3.18	3.74
5 years	2.94		3.04	3.20	3.93

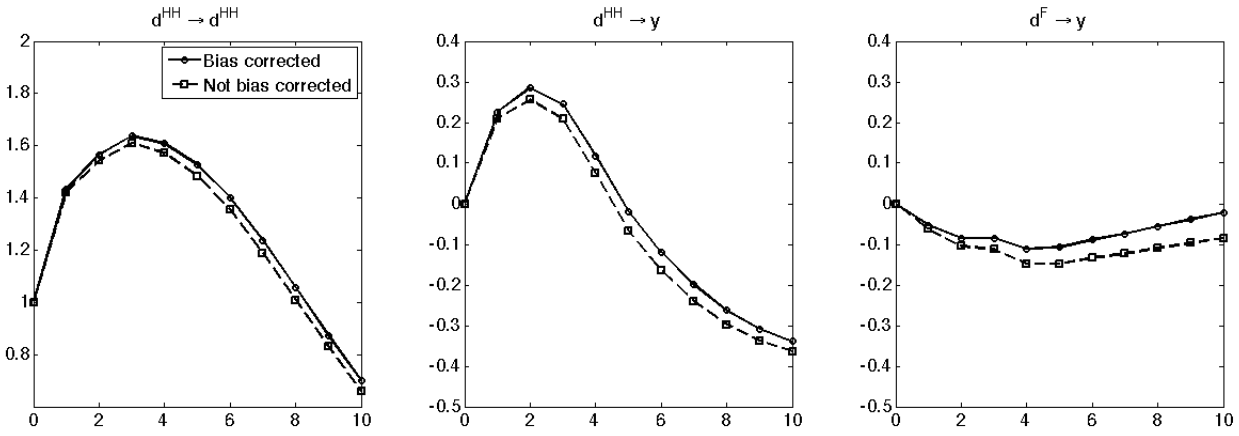
Notes: This table shows the root means squared errors from pseudo out-of-sample forecasts of one-year GDP growth over the following five years. Root mean squared forecast errors from the IMF and OECD are computed using realized growth in year t reported in year $t+2$ reports. VAR forecasts refer to forecasts from a three variable VAR using real GDP growth, the change in household debt to GDP, and the change in non-financial firm debt to GDP. The VAR is estimated on the pooled sample. AR forecasts refer to forecasts from an autoregressive model of GDP growth estimated on the pooled sample. Both VAR and AR models include five lags. RW forecasts refer to forecasts from a random walk model (no change).

Table A6: Global Household and Firm Debt and Global Growth: Robustness

	Dependent variable: global average $\Delta_3 y_{t+3}$				Dependent variable: global aggregate $\Delta_3 y_{t+3}$	
	(1)	(2)	(3)	(4)	(5)	(6)
Global $\Delta_3 d^{HH}_{t-1}$	-0.406^{+}	-0.589*	-0.807**	-0.687**		
	(0.235)	(0.275)	(0.203)	(0.220)		
Global $\Delta_3 d^{F}_{t-1}$	-0.0149	0.0646	-0.164	-0.0613		
	(0.129)	(0.173)	(0.126)	(0.149)		
Global agg. $\Delta_3 d^{HH}_{t-1}$					-0.594*	-0.316
					(0.288)	(0.272)
Global agg. $\Delta_3 d^{F}_{t-1}$					0.0552	0.101
					(0.144)	(0.222)
Trend	-0.195**	-0.172*	-0.794**	-0.882**		
	(0.0523)	(0.0752)	(0.133)	(0.145)		
Trend^2			0.0126**	0.0157**		
			(0.00321)	(0.00356)		
Sample	Full	Pre 2006	Full	Pre 2006	Full	Pre 2006
Distributed lag in Δy	✓	✓	✓	✓	✓	✓
Test for equality of β_{HH} and β_F, p-value	.195	.0342	.0138	.0375	.0756	.3634
R^2	.586	.542	.7	.728	.246	.132
Observations	46	40	46	40	46	40

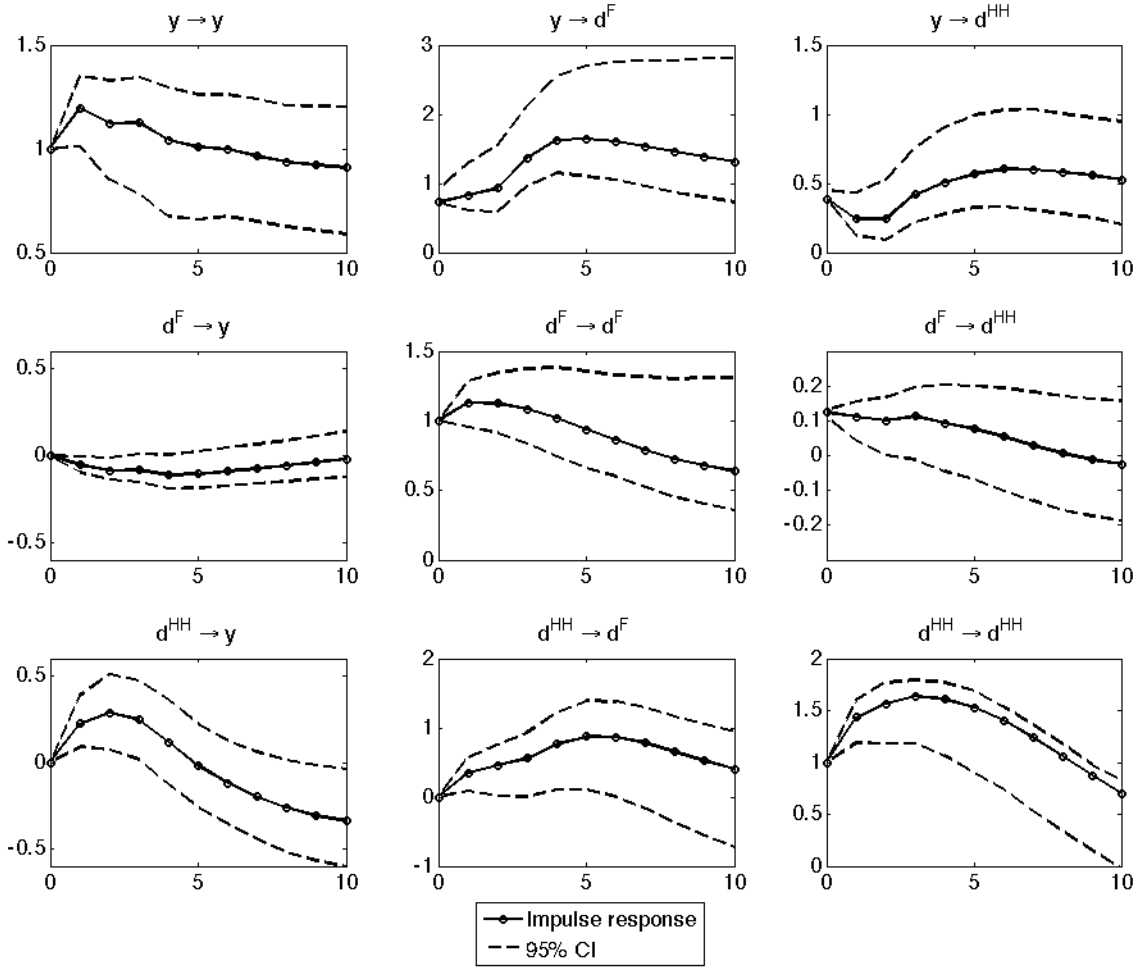
Notes: This table reports several robustness tests for the global time series regressions in Table 13. Columns 1-4 control for a linear or a quadratic trend in the specification in Table 13 for the full and pre-2006 samples. Columns 5-6 compute the global variables by summing the dollar levels of all variables and then computing each variable based on the summed global aggregate. Each column includes three lags in the global one-year change in log GDP, computed using the relevant aggregation method. Newey-West standard errors in parentheses are computed with 6 lags. +,*,** indicates significance at the 0.1, 0.05, 0.01 level, respectively.

Figure A1: Baseline and Bias Corrected VAR Impulse Responses



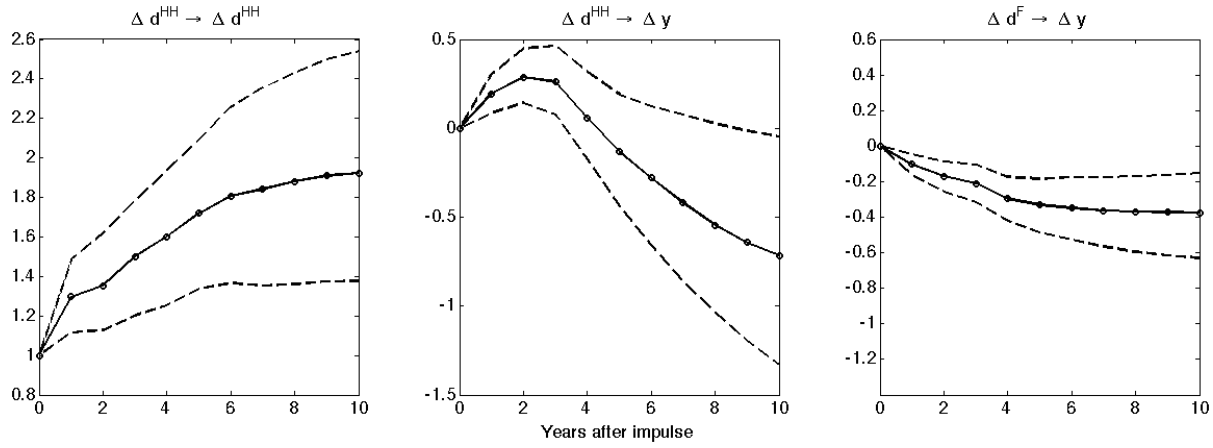
Notes: This figure presents uncorrected and bias corrected impulse responses from a three variable recursive VAR in log real GDP, firm debt to lagged GDP, and household debt to lagged GDP. The dash line is from the baseline VAR, and the solid line is the impulse response from the VAR corrected for Nickell bias using an iterative bootstrap bias correction procedure. Specifically, the procedure iterates on the VAR coefficients until the VAR estimates from pseudo-samples constructed with the bias-corrected coefficients is sufficiently close to the (biased) OLS estimates.

Figure A2: Full Set of Impulse Response Functions from a Recursive VAR in Real GDP, Non-financial Firm Debt, and Household Debt



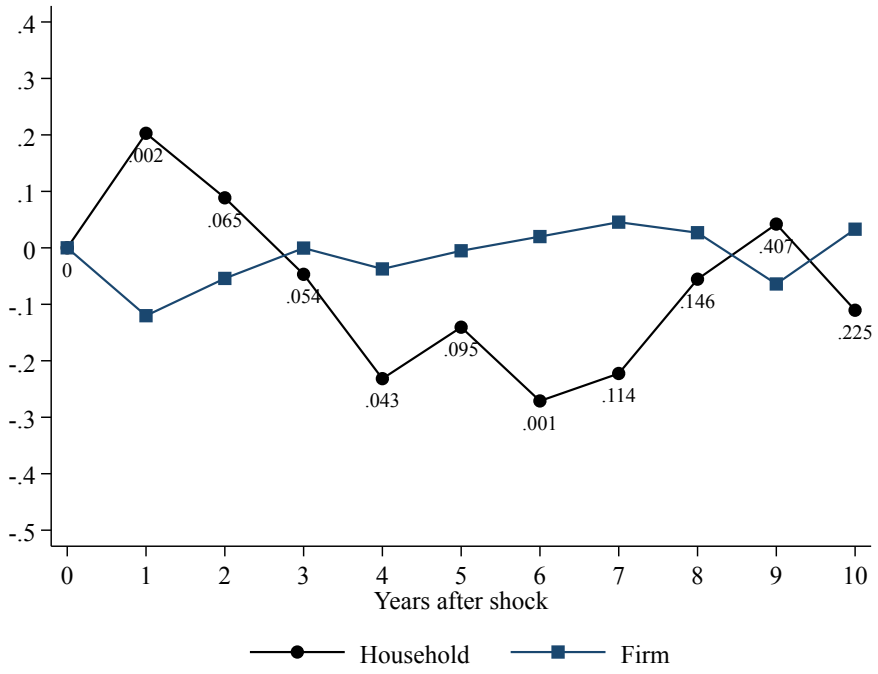
Notes: This figure presents impulse responses from a three variable recursive VAR in log real GDP, firm debt to lagged GDP, and household debt to lagged GDP. The shocks are identified using a Cholesky decomposition with real GDP ordered first and household debt last. The impulse responses are from a VAR in levels with country fixed effects estimated on the 30 country sample. The reduced form VAR coefficient estimates are corrected for Nickell bias using an iterative bootstrap procedure. Dash lines represent 95% confidence intervals that account for contemporaneous cross-country residual correlation and are computed by resampling cross-sections of residuals using the wild bootstrap.

Figure A3: Cumulative Responses to Debt Shocks from a Recursive VAR in First Differences



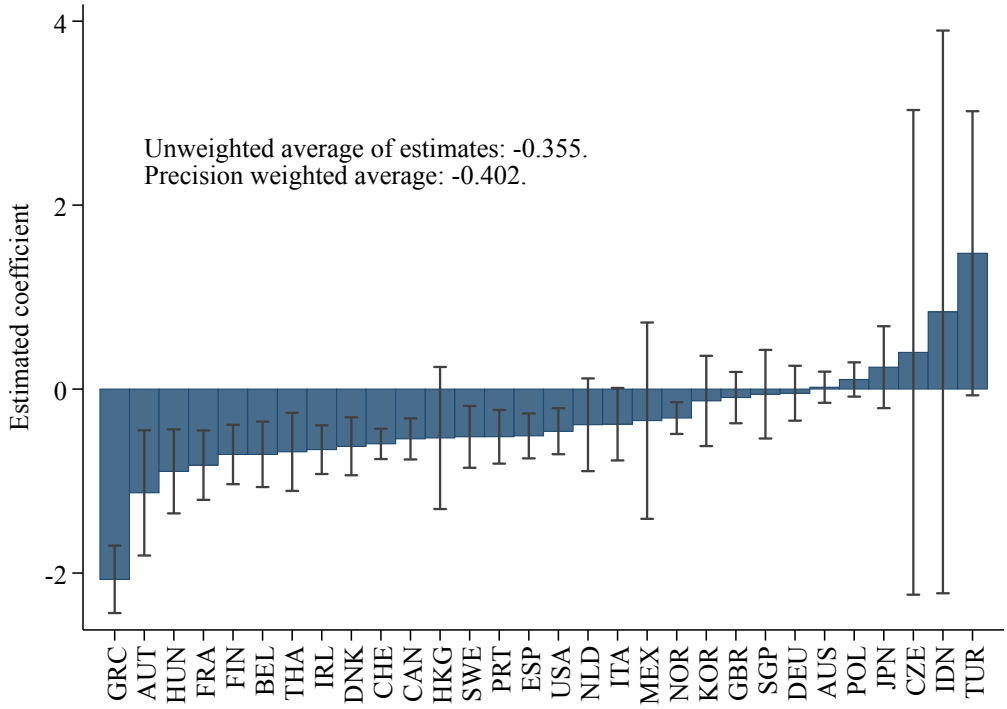
Notes: This figure shows cumulative impulse responses to household and firm debt to GDP shocks from a three variable VAR in real GDP growth, the change in firm debt to GDP, and the change in household debt to GDP. The impulse responses are identified using a Cholesky decomposition with the ordering $\left[\Delta \ln Y_{it}, \Delta d_{it}^{F}, \Delta d_{it}^{HH}\right]$. The VAR in first differences is estimated without country fixed effects. Dash lines represent 95% confidence intervals that account for contemporaneous cross-country residual correlation and are computed by resampling cross-sections of residuals using the wild bootstrap.

Figure A4: Test of Equality between the Response of Annual GDP Growth to Household and Firm Debt Shocks



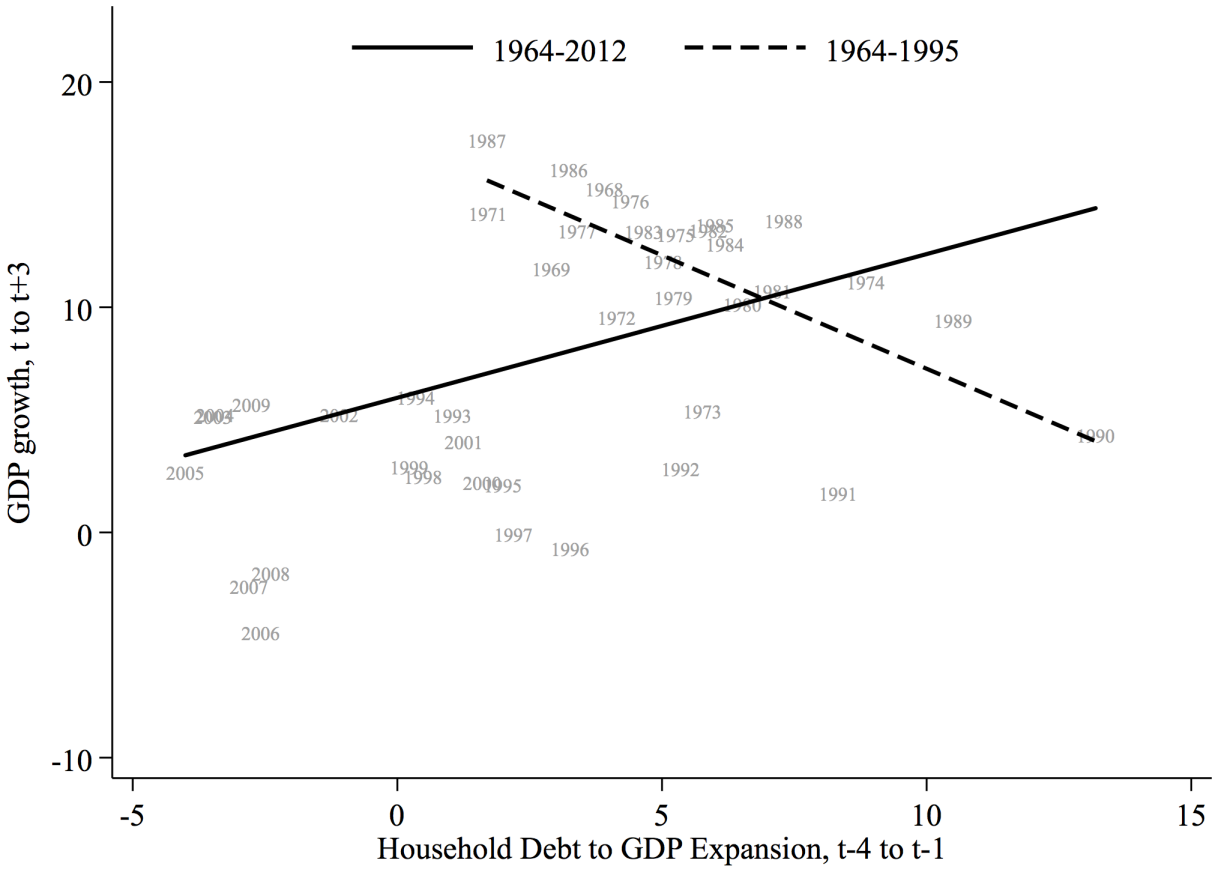
Notes: This figure plots impulse responses for one-year GDP growth from Jordà (2005) local projections estimated in first differences. The specification is: $\Delta y_{it+h-1} = \alpha_i^h + \sum_{j=1}^{5} \beta_{HH,j}^h \Delta d_{it-j}^{HH} + \sum_{j=1}^{5} \beta_{F,j}^h \Delta d_{it-j}^{F} + \sum_{j=1}^{5} \delta_j^h \Delta y_{it-j} + u_{it+h-1}^h$, for horizons $h = 1, ..., 10$. At each horizon we report the p-value for the two-sided test of equality between the household and firm debt local projection impulse response coefficients ($H_0 : \beta_{HH,1}^h = \beta_{F,1}^h$ against $H_A : \beta_{HH,1}^h \neq \beta_{F,1}^h$).

Figure A5: Estimates of $\beta_{HH,i}$ for Each Country



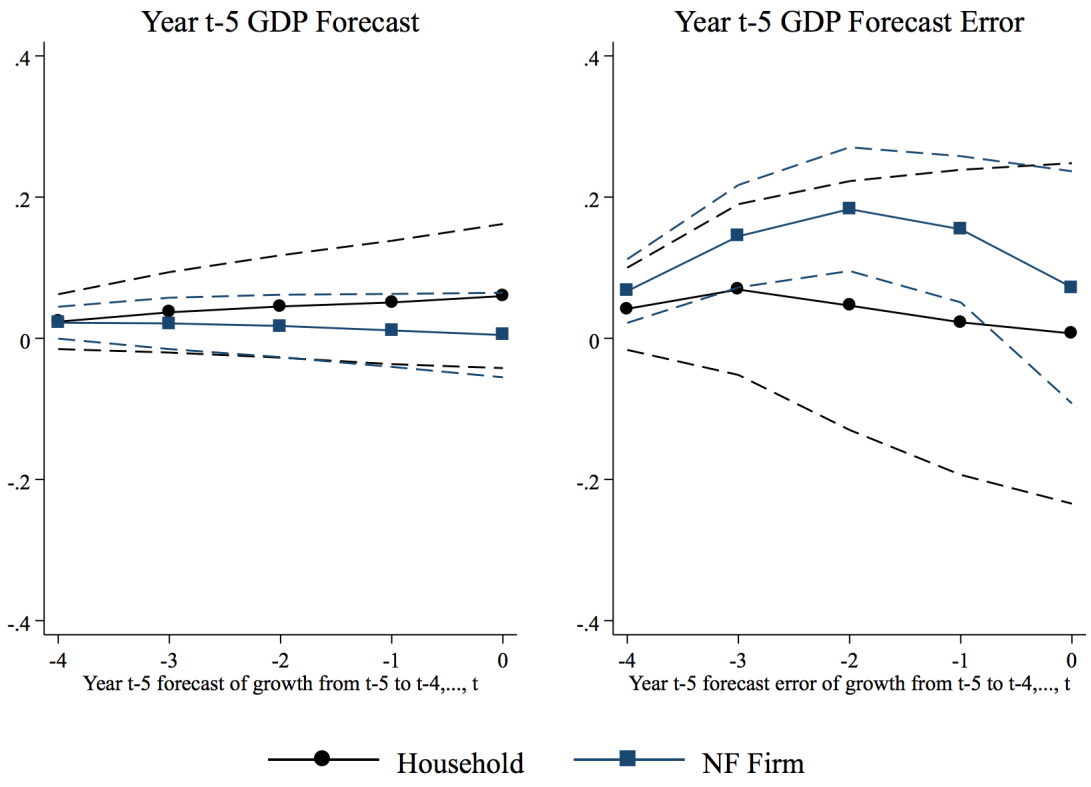
Notes: This figure plots $\beta_{HH,i}$ from the time series regression, $y_{it+3} - y_{it} = \beta_0 + \beta_{HH,i}\Delta_3 d^{HH}_{it-1} + \sum_{j=1}^{3} \gamma_j \Delta y_{it-j} + \epsilon_{it}$, estimated separately for each country i in the sample. Regressions for Ireland (IRL) and Indonesia (IDN) control for $\Delta_3 y_{it-1}$ instead of a distributed lag in GDP growth as a consequence of the limited degrees of freedom. The unweighted average of the estimates refers to the raw average of the coefficients in the figure, and the precision weighted average is the average weighted by the inverse of the squared standard error. Bands around the estimates represent 95% confidence intervals.

Figure A6: Household Debt Expansion and Growth: The Case of Japan



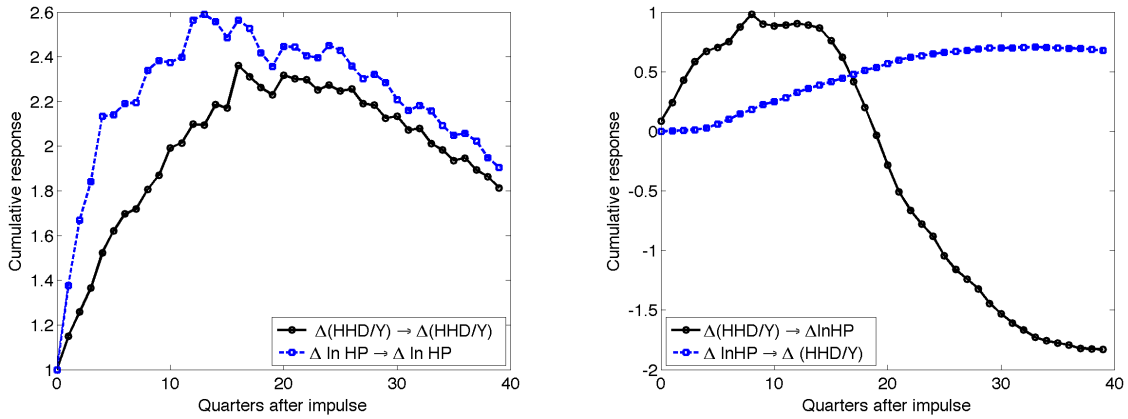
Notes: Japan represents an interesting case and helps reveal the difficulty in specifying a "timing" of the recessionary effects of a household debt boom. This figure plots the relationship between GDP growth from t to $t+3$ and the expansion in household debt to GDP from $t-4$ to $t-1$ for Japan. Each point refers to year t. The solid black line is the least squares fit for the whole period (1964-2012), while the dash line shows the least squares fit for 1964-1995. The figure shows that the relation between the change in household debt to GDP ratio and subsequent growth for Japan is negative and strong if we use a sample period of 1964 to 1995, which includes the beginning of the lost decades period. But after 1995, the Japanese economy continued to exhibit very low growth, and household debt was shrinking during this period of anemic growth, inducing a positive relation. Related to this observation, controlling for lagged GDP growth mitigates the positive coefficient for Japan when using the full sample period.

Figure A7: Debt Expansions and Preceding IMF Forecasts



Notes: The left panel plots coefficient estimates from: $\Delta_h y^{IMF}_{it-5+h|t-5} = \alpha^h_i + \beta^h_{HH}\Delta_3 d^{HH}_{it-1} + \beta^h_F \Delta_3 d^F_{it-1} + \epsilon_{it}$, where $\Delta_h y^{IMF}_{t+h-5|t-5}$ is the IMF forecast of growth from $t-5$ to $t-5+h$ made in year $t-5$. The right panel shows estimates from the same equation where the dependent variable is the forecast error. Dash lines represent 95% confidence intervals, computed using standard errors dually clustered on country and year.

Figure A8: Impulse Responses from a Bivariate VAR in Household Debt to GDP and Real House Prices

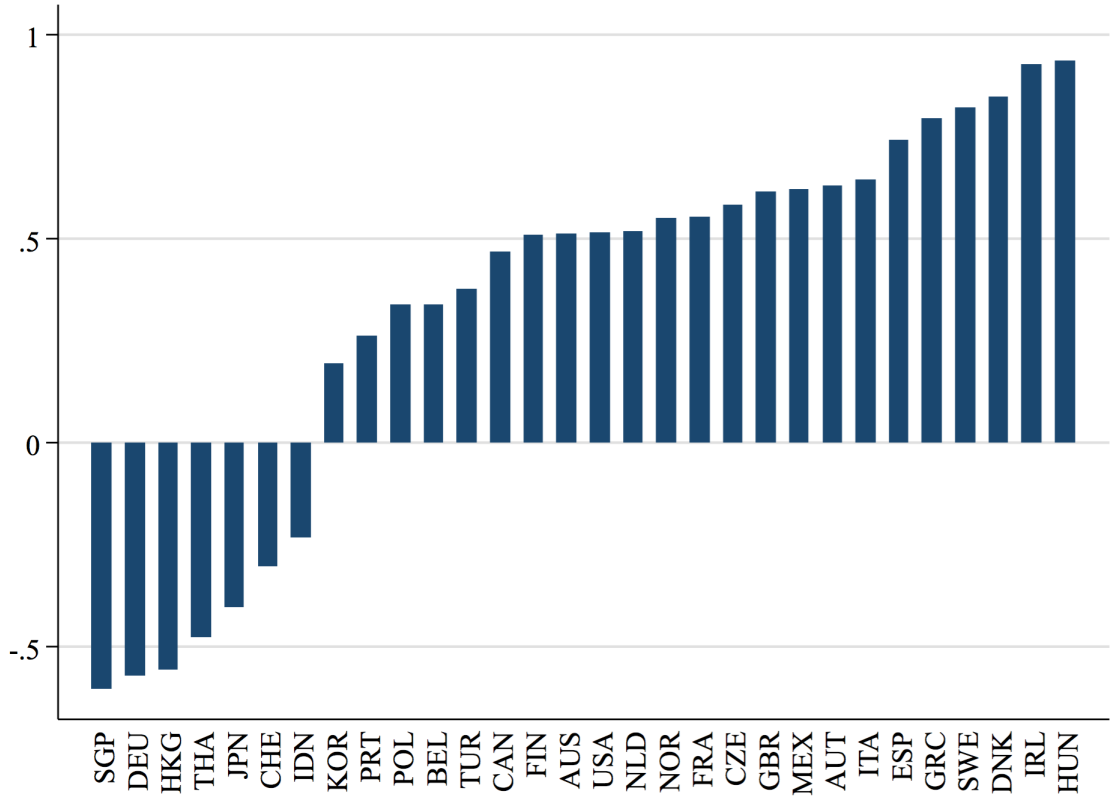


(a) Responses to Own Shocks

(b) Responses to Other Variable Shock

Notes: The figure shows cumulative impulse responses from a bivariate VAR in the change in household debt to GDP and the change in log real house prices using quarterly data. The shocks are orthogonalized using a Cholesky decomposition with household debt ordered first. Consistent with the lag length used for the three-variable VAR, this VAR is estimated with 20 lags.

Figure A9: Correlation with World Household Debt Cycle



Note: This figure shows the correlation between the three-year household debt to change for country i and the average change for all countries excluding i: $\text{corr}\left(\left(\Delta_3 d^{HH}\right)_{it}, \frac{1}{N-1}\sum_{j\neq i}\left(\Delta_3 d^{HH}\right)_{jt}\right)$.